



## **U.S. House of Representatives**

Committee on Science, Space, and Technology  
Subcommittee on Research and Science Education

*STEM Education in Action: Local Schools, Non-Profits  
and Businesses Doing Their Part to Secure America's Future*

Monday, April 30, 2012 – 10 a.m.  
Bob Jones High School, Madison, Alabama

Testimony of Dr. Robert A. Altenkirch  
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**□) What role does your institution play in helping the U.S. economy? Please discuss the role of your institution in providing a skilled workforce to the local and regional economy, particularly with regard to STEM fields.**

Our campus plays an important role in critical areas for the United States, most notably in America's national security and the exploration of space. However, UAHuntsville has also emerged as a national leader in the understanding of Earth science, particularly as it relates to severe weather and global climate change. And, while aeronomy may be an esoteric topic, our world-renowned research in astrophysics and heliophysics are creating solutions for the significant, and often disruptive, impact of solar activity on the planet.

The University of Alabama in Huntsville is a Tier 1 national university as ranked by U.S. News & World Report, and we have achieved the highest rank in research activity by standards established by the Carnegie Foundation for Teaching. Our campus serves as the anchor tenant of Cummings Research Park, the second largest university-related research park in the United States with nearly 300 companies and 25,000 employees. Redstone Arsenal is nearby, where NASA's Marshall Space Flight Center and several U.S. Army research laboratories and commands are located.

It is this environment in that we find ourselves in the vortex of workforce development that is heavily dependent upon research, technology, science, engineering and mathematics.

At The University of Alabama in Huntsville, our students, faculty, and staff are engaged in the pursuit of new knowledge, and the creative application of that new knowledge, to solve critical challenges facing our nation. Progress in solving these critical challenges is essential to the future security, vitality, and future of the United States. We believe the solutions to these challenges are derived through STEM activities at the highest level.

Last year, we supplied the greater Huntsville area with more than 630 graduates possessing degrees of a technical nature. Nearly half of our graduates earn a degree in science or engineering, so we are the single largest contributor of professional degrees in growing the regional STEM workforce.

Also, our institution prepares elementary and secondary teachers who, in turn, prepare the future workforce for the local and regional economy. With regard to STEM disciplines, the Department of Education prepares both math and science teachers, and we take an integrative approach to elementary education, making sure future teachers teach children that science, technology, engineering, and math are integrated and not distinct entities.

## **2) How do you partner and collaborate with local businesses, non-profits, other schools and institutions of higher learning, and local and state government to create an educated and skilled workforce?**

Engagement of students entering the workforce, as well as engagement of life-long learners already in the workforce within these research and academic lines of inquiry helps build - and more importantly helps maintain - a strong and educated workforce that can bring value to our society.

The University of Alabama in Huntsville has lengthy, established relationships with numerous companies, and government agencies as well as regional school systems, colleges and universities that are helping to create a graduate that is ready to step into the workforce and begin making immediate contributions.

Our cooperation education program is one of the largest in the southeastern United States with approximately 650 participating students, primarily in science and engineering, but business and health care also play an increasingly important role in this program. This program consists of students who are working at an area company or government agency to get actual work experience in the workplace for a semester, and then returning to the campus for the next semester to receive classroom instruction and hands-on laboratory experience.

Through our Integrated Product Teams (IPT) program we are preparing senior engineering students to transition to the workforce by having them work as a team to solve a large-scale systems design project. We are also using the Innovative System Project for the Increased Recruitment of Emerging STEM Students

(InSPIRESS) program as an outreach activity that engages high school students in an open ended design activity that engages their interest, excites their imagination, and gives them a better understanding of what scientists and engineers do. This also increases their interest in science and engineering careers as well as helping them develop more realistic views of what it takes to be a scientist or engineer (i.e., you don't have to be a genius to be an engineer, there is more to engineering than just calculations, etc.).

The Integrated Product Team program has grown tremendously during the last several years through the strong support of the U.S. Army and NASA's Marshall Space Flight Center. It is a unique engineering senior design experience that engages UAHuntsville seniors in mechanical and aerospace engineering and industrial engineering. The college portion of the IPT program consists of about 80 students from our campus along with students from the College of Charleston and ESTACA (Ecole Supérieure des Techniques Aéronautiques et de Construction Automobile in Paris, France). These college teams compete to be selected as the best design of a project conceived by the Army or NASA.

The high school component of the IPT program (InSPIRESS) will include 240 students in the spring 2012 semester. Those students are divided among 30 teams from 12 high schools from across North Alabama and have been asked to design a science payload to be included in the spacecraft designed by the UAH students. The participating high schools include: Sparkman, Bob Jones, Scottsboro, West Point, Cold Springs, Good Hope, Albertville, Austin, and Lee high schools from Alabama.

Federal agencies, local organizations and companies are very supportive of both these programs by serving as mentors for the teams and by serving as judges for the various evaluation events and boards throughout the semester.

The university's Institute for Science Education and AEGIS Technologies are working on a comprehensive middle school-through-high school STEM pipeline, aimed at 1) engaging students in STEM activities during a two-week summer science and engineering camp at the critical time before 8<sup>th</sup>-grade, where research has shown interest in STEM disciplines suffers a precipitous decline; 2) keeping them engaged in STEM activities, education, and career opportunities throughout the academic year; 3) sustaining both the summer camp and academic year experiences in subsequent years through grade 11. This pipeline culminates in their admission to a UAH STEM major.

The university's Department of Education collaborated with The Schools Foundation to conduct more than 100 meetings during a six-month span to improve education in all three school systems as part of their SPEAK UP! campaign. The department is also engaged with the Huntsville City Schools on a "Paving the Way" grant from the Department of Defense to work with secondary mathematics teachers to incorporate project-based learning in their classrooms.

The University of Alabama in Huntsville is expanding opportunities for high school students to become engaged earlier in college curriculum through dual enrollment classes. Area high school students can supplement the classes that are available in their high schools, and earn both high school and college credit for such classes. UAHuntsville has recently established an Early Start program for those high school seniors who will be graduating at the end of their fall semester to enroll in the spring semester on our campus.

The University of Alabama in Huntsville is also providing leadership as the regional coordinator for 10 North Alabama high schools to better prepare Alabama students for engineering careers through the Alabama Engineering Academy Initiative. These academies are embedded in the high schools and provide specific, multi-year curriculum geared toward prospective engineering students.

**3) What are the major challenges that limit the performance of students in STEM subjects, particularly in their first two years of post-secondary education? What challenges do you face in retaining students pursuing STEM certificates and degrees? If applicable, please describe how your institution contributes to K-12 STEM education?**

This summer marks the beginning of the new MSI-STEM degree program at The University of Alabama in Huntsville — the Master of Science in Integrated Science, Technology, Engineering, and Math (MSI-STEM). This master's degree program is targeted at in-service secondary school science and math educators and seeks to advance their content knowledge and subject-matter command, which in turn have been proven to positively impact student learning in the STEM areas.

MSI-STEM courses will be offered over the summer and on weekends, so as to be accessible to teacher-participants, and will presuppose a level of preparation typical of middle school science or math educators. Content courses will be contextualized to Alabama Course of Study standards, the Next Generation Science Standards (when available), and the highly successful Alabama Math, Science, and Technology Initiative (AMSTI), in order to relate content knowledge directly to the curriculum and academic areas in which the teacher provides instruction (an important factor in teacher motivation and learning).

The national need for such programs was first highlighted in the 2005 National Academies' *Rising Above the Gathering Storm* report, which gave such efforts their highest recommendation for ensuring a STEM-competent workforce in the 21<sup>st</sup> century. In 2010, this call was reiterated and strengthened in *Rising Above the Gathering Storm, Revisited: Rapidly Approaching Category 5*. Recently, the National Science Foundation (NSF) has made the establishment of teacher content-knowledge programs a major aim of their Math Science Partnership (MSP) effort, and the U.S. Department of Education's MSP program now lists teacher content knowledge as a prime issue to be addressed in funded activities. There is

no similar program within Alabama, and only three others in the southeastern United States.

One major challenge is the difficulty for many students to engage in higher order thinking skills, the arguable result of more than a decade of federal policy that has forced teachers to dumb down curricula and ignore higher order, critical thinking, which can't be evaluated by current tests. Importantly, in the city of Huntsville, research shows that K-8 teachers are ignoring subjects such as science and engineering because they are not tested. Research shows this is a national trend, especially in less affluent school systems.

This leads to another key challenge in dealing with entering students. Many of them are not prepared for college work. A recently published study by ACT found that only 45 percent of graduating high school students are ready for college work in mathematics and only 30 percent are ready for college work in science. For some ethnic groups the numbers are even lower. This leads to lower retention because many entering students do poorly in college classes and become discouraged.

#### **4) How do you prepare your students to continue with a four-year degree or enter the workforce upon completion of their academic program?**

Students at UAHuntsville acquire not only subject matter competence, but also learn critical thinking and problem solving skills that are applicable throughout their careers in graduate study or the workforce.

In order to prepare our senior engineering students for the work force we have them participant in a project-based learning environment that forces them to use their engineering knowledge to solve a real-world problem. We create a realistic environment in which they have a project manager and a leadership team that report to the course instructors – the leadership and their team must determine what tasks need to be accomplished – they know what the deliverables based on the syllabus but they must determine how to complete those deliverables. This two semester experience is forcing them to do the same activities they will be doing when they join the workforce – it also forces them to work as a team, exercise their engineering skills and abilities, and learn to communicate more effectively.

UAHuntsville has several noteworthy programs that help students with their transition from their "first career" as a student, into their "second career" as a professional. These include: "Students Working in Parallel with the Army" program on Redstone Arsenal; immersive research programs in Panama and Germany which engage students in real-world challenges and problem-solving; and opportunities for students to engage as part of professional workforce through conferences and symposia, on campus and around the world.

Each of these steps help prepare the UAHuntsville graduate for life after being a

student, and helps them add value to their employer from the first day they walk in the door.

**5) How can we attract, educate, and retain the critical mass of talent necessary to keep the state of Alabama – and the country as a whole – at the forefront of research, development, and groundbreaking advances in science and technology?**

We are making great strides in this area by “teaching the teachers” on STEM education. Our campus was the pilot site for the Alabama Math, Science and Technology Initiative. This initiative was created by a NASA grant to UAH. This program has been successful and is now replicated at universities all across the state of Alabama. A recent multi-year study funded by the U.S. Department of Education credited the AMSTI program with providing the equivalency of an additional 28 days of traditional classroom instruction per year.

AMSTI is a program for elementary and middle school teachers, emphasizing the implementation of hands-on or inquiry-based learning in science and math classrooms. Significant teacher professional development is necessary, as they typically have never been exposed to this style of learning and teaching. Training is conducted year round at the UAH Institute for Science Education and offsite at our two-week summer institute. AMSTI provides all classroom materials for a given lesson, in the form of a “module.” These modules are delivered to schools, used in the classrooms, and returned to our campus, where they are refurbished and replenished for the next teacher or school. AMSTI offers units on a wide range of science and math topics, such as climate and weather, geology, energy, force and motion, plants, genetics, and anatomy.

During the past five years, our institute has trained more than 4,000 teachers on inquiry-based education and has had an impact on more than 120,000 students. Our AMSTI schools outperform non-AMSTI schools in middle-grade science and math by more than 5 percent (measured by SAT-10).

Further, there is a need to help our citizens develop a vision for STEM careers. Currently, prospective students have a highly exaggerated view of what it takes to pursue these careers. For example, you have to be a genius, or you have to have gotten A’s in all your math and science classes to pursue careers in a technology field.

At younger ages — elementary and middle school — we need to help students gain a better appreciation of what engineers and scientists do. Outreach efforts by UAH faculty and staff are giving them opportunities throughout their K-12 career to engage in STEM career type activities (design, programming, etc.). This will allow us to develop more integrated approaches and programs that build on one another

so that students can anticipate future activities as they progress into later grades. We also link these programs to university programs in science, technology, engineering, and math so that students can see what the end result is – that is what degree programs they can pursue and what their careers might look like.

Universities in Alabama need to have strong encouragement, rather than discouragement, to recruit out of state students interested in the STEM disciplines. Demographics in Alabama will continue to shrink the pool of Alabama students entering universities to study technology-based disciplines. If we can get the students into Alabama universities, including UAHuntsville, we can educate them and retain them in the state. Our campus has a very good track record in this area. Two out of three of our graduates remain in the greater Huntsville area and three out of four of our alumni remain in Alabama.

We can do this with a two-pronged approach: (1) by increasing the number of students who go to college, develop the deep and broad education and analytical reasoning skills needed to be successful, and (2) since our population of young people in Alabama is not growing as rapidly as it once did, aggressively recruit the best and brightest from other parts of the world so they will relocate here, raise their families here, start new businesses here. Universities have been catalytic in this type of highly educated immigration for generations.

## **6) How can we ensure that we provide sufficient opportunities to allow students, researchers, educators, and employees to become and remain current and competitive in our rapidly evolving world?**

The Congress and the President can work to provide healthy, consistent and sustained funding for America's most important research-based activities — including a strong government-centric space program and national defense. Fundamental research through agencies, such as the National Science Foundation, is critical.

People go where the work is exciting, cutting-edge, and promises opportunity for more than just fulfillment of their basic economic needs. Many of these activities should be based on timescales longer than the election cycle. We must find a way to maintain the focus and advancement of these programs and activities despite the difference in timescales. It fails to serve the national interest when we cannot continue on a path where each election cycle re-opens the conversation of why a particular program must be radically altered - or canceled, perhaps, only because it was the idea of the previous administration or Congress – or to serve the short-term political interests of the person elected, and thereby perpetually forego the longer-term national strategic goals for which the program or activity is required.

We must also be able to better understand that it takes to be competitive in today's

world: 1) What does the “competition” look like (i.e., what can they do?) and 2) What must I/we be able to do to stay abreast of them (i.e., the competition)? Then we must determine ways to motivate people to develop those skills and abilities.

Make education fun and engaging. Embrace technology and some level of creativity (social networking, podcasts, video, gaming) as a means by which everyone can be involved and stay current. I suspect this is less of a problem in society now than it was 20 years ago or more.

Finally, we need to do a better job of helping everyone realize the value and necessity of advanced technical education and the positive impact of research on the community, the economy, and the nation.